

DRAFT Anthrax Fact Sheet^(*)

I. Introduction

Anthrax is a zoonotic disease that primarily infects animals. A highly virulent gram-positive spore forming, non-motile, non-hemolytic spore former, *Bacillus anthracis* cause the anthrax disease ⁽¹⁾.

Much is known about the virulence of this organism in that virulent *Bacillus anthracis* contains 2 large plasmids that are responsible for pathogenesis. These 2 plasmids have been identified as the pXO1 and the pXO2 plasmids that codes for specific non-toxic proteins. The pXO1 plasmid carries the protective antigen (pag), lethal edema factor (lef), and adenylate cyclase (cya) toxin genes. The pXO2 carries the capsule genes (capA, capB, capC). Virulence occurs with microbes that contain both these plasmids. The combination of these toxin proteins will result in necrosis of tissue ⁽²⁾.

There are three forms of disease:

- Cutaneous anthrax is the most common naturally occurring form of anthrax with an estimated 2,000 worldwide cases per year. In the U.S. 224 cases of cutaneous were reported from 1944 to 1994. Cutaneous anthrax usually results from direct contact with animals or their products containing the infectious *Bacillus anthracis*. At the site of infection, a small red pimple begins to spread into a ring of vesicles, surrounding a central papule. This ulcerate forms a black eschar with spread and new vesicles ranging from 2-10 cm in diameter with edema and blistering surrounding the lesion. Untreated cases have a fatality rate between 5% and 20% ⁽¹⁾.
- Inhalation (pulmonary) anthrax occurs from the inhalation of bacterial (8,000 – 10,000) spores. Natural occurring inhalation anthrax is rare in the United States (U.S.) with 18 reported cases from 1900 to 1976. The pulmonary form is highly contagious but has a very low potential for transmission by aerosols from persons-to-persons. Pulmonary anthrax is characterized by rapidly developing hemorrhagic pneumonia, with involvement of the lymph nodes and the system draining lungs; toxemia with severe mucosal congestion; terminal hemorrhaging from body orifices and finally coma followed by death.
- Gastro-intestinal anthrax is rare that results from the ingestion of contaminated materials. Gastro-intestinal anthrax is uncommon but has been reported in Africa and Asia. The disease is characterized as glandular swelling of the mouth and throat; acute gastroenteritis; abdominal pain, and prostration. Septicemia develops followed by coma and death.

Avirulent strains are deficient in carrying either or both plasmids. The Stern Strain used for vaccination carry only the pXO1 plasmid. The Pasteur strain is a non-vaccine avirulent strain that carry only the pXO2 plasmid. The Ames strain is a non-vaccine avirulent strain does not carry any plasmids.

The recognition of the potential properties of anthrax spores as a warfare agent dates back to World War I. The anthrax disease represents the single greatest biological warfare threat today. Such potential properties includes:

- highly lethal (if untreated),
- easy to produce large quantities,
- relatively easy to develop as a weapon,
- easily spread over large areas,
- easily to store and dangerous for long periods.

II. HAZARDS AND RISKS

Bacillus anthracis, the causative agent for the anthrax disease, is classified as a Risk Group 2 agent (where therapeutic intervention is available) by both the National Institutes of Health (NIH)⁽³⁾, and the Centers of Disease and Prevention (CDC)⁽⁴⁾. The United States government has also declared this agent as a “Select Agent”⁽⁵⁾⁽⁶⁾.

The disease is first localized but progresses from the primary lesion on the skin, lungs, or bowel by spreading locally or systemically through the blood or lymphatic systems (i.e., lymph nodes). The invading bacteria will eventually gain access to the circulatory system and result in an overwhelming rapid septicemia, followed by coma and death. As recent risk assessment performed by the Defense Research Establishment Suffield in Canada⁽⁷⁾ on *Bacillus anthracis* showed that the progress of the disease depends on the:

- route of infection,
 - dermal
 - inhalation
 - ingestion
- size of the inoculum,
 - 100 billion colony forming units = 1 gram
 - 1 gram = 1 trillion spores
 - 8,000 to 10,000 spores = lethal dose
 - 1 gram = 100 million lethal doses
- health status of the infected host,
 - immuno-compromised versus healthy individuals
- toxicity or virulence of the infecting strain
 - Avirulent strains (e.g., Ames, Stern, Pastuer)

- Mode of transmission
 - Airborne
 - Contact

Documents from USAMRIID ⁽⁸⁾ and the Defense Intelligence Agency⁽⁹⁾ have determined that *Bacillus anthracis* would make an effective biological agent. As seen in Table 1, approximately 0.2 kilograms of dried material would be required to exposure a 100 square kilometer area under ideal meteorological conditions.

Table 1:

Quantity of Biological or Chemical Agent Required for a 100 Sq Foot Area ⁽⁸⁾⁽⁹⁾

	Type	Agent (Disease)	Quantity Required (Kilograms)
1	Biological Agent	<i>Francisella tularensis</i> (Tularemia)	0.2
2	Biological Agent	<i>Bacillus anthracis</i> (Anthrax)	0.2
3	Biological Material	Botulinum Toxin	8.0
4	Biological Material	Ricin	8,000
5	Biological Material	Aflatoxin	8,000,000 (8,000 Metric Tons)
6	Chemical Agent	Sarin	100,000 (100 Metric Tons)

The World Health Organization estimated that three days after a 50 kg release of anthrax spores along a 2 km line upwind a city with a population of 500,000 people would result in about 125,000 infections resulting in approximately 95,000 deaths. As result, this would make a formable weapon of mass destruction ⁽¹⁰⁾. The Sverdlovsk Anthrax Outbreak of 1979 is a case of an anthrax exposure that killed at least 66 people in the Union of Soviet Socialist Republic ⁽¹¹⁾⁽¹²⁾.

III. RECOMMENDATIONS

It is important for all personnel working with such materials to be advised of the potential mode of transmission, and to use the proper precautions listed below. The following work practices may be more or less conservative than those practiced at other facilities.

Work Practices:

- General Work Practices: As recommended in CDC's Biosafety in Microbiological and Biomedical Laboratories, a Biosafety Level 2 containment level using biosafety level 2 work practices are required for handling, and use of non-aerosolize concentrations of research amount (less than 10 liters) of *Bacillus anthracis* in research facilities. Additionally,

users of this agent (in the USA) must also comply with public health regulation: 42 Code of Federal Regulations 73.4, and U.S. Department of Agriculture regulation: 9 Code of Federal Regulation 121.3 when handling, storing, transporting, and in the disposing of such materials ⁽⁵⁾⁽⁶⁾.

- Medical Surveillance: Enrollment into the Medical Surveillance Program at your facility is mandatory. In accordance with a NIH document, "Laboratory Safety Monograph, a supplement to the Guidelines for recombinant DNA research" dated July 1978 ⁽¹³⁾:
 - immunization is generally recommended for people at risk (i.e., laboratory workers) who will be engaged in research with infectious agents for which an effective vaccine is available.
 - At some institution, prior immunization may be required for certain employed positions as a condition of employment.
 - Where immunization are required, evidence of antibody response should be demonstrated, whenever possible, before an employee begins to work with infectious organisms.

A safe and effective human protein based anthrax vaccine has been licensed in 1970 for pre-exposure prophylaxis. Where immunization are required, evidence of antibody response should be demonstrated, whenever possible, before an employee begins to work with infectious organisms.

- The vaccine is a formalin-treated culture of supernatant of an avirulent *B.anthraxis* strain.
 - The vaccine is administered at 0, 2, 4 weeks and at 6, 12, 18 months. Persons continuing to be at risk for exposure should receive yearly boosters.
 - The vaccine should be administered healthy individual between 18-65 years of age.
 - Counter indication would include individuals who are pregnant, or under prescription medication.
 - Endemic strains of *Bacillus anthracis* are typically sensitive to various antibiotics including penicillin G, ciprofloxacin, doxycycline
 - Post exposure prophylaxis against anthrax may be achieved with oral ciprofloxacin or doxycycline
- Decontamination:
 - 8% Paraformaldehyde gas for 180 minutes ⁽¹⁴⁾,
 - 2% glutaraldehyde for 15 minutes ⁽¹⁴⁾
 - 10% hydrogen peroxide for 60 minutes ⁽¹⁴⁾
 - 2500 ppm (5%) sodium hypochlorite for 30 minutes, ⁽¹⁴⁾
 - vapor hydrogen peroxide (20%) at 2 mg/L for 0.17 to 0.30 minutes
 - Isopropyl alcohol with 5% propylene oxide for 1 minute: ⁽¹⁴⁾

- 6% hydrogen peroxide for 10 minutes to disinfect, 25% hydrogen peroxide to sterilize: ⁽¹⁴⁾
- 5% phenol for 30 minutes ⁽¹⁵⁾

Engineering Controls

- Engineering controls are used to isolate or remove hazards from the workplace in order to reduce the potential for exposure. Engineering controls in combination with safe work practices that alter the manner in which tasks are performed are expected to be primary means of eliminating or further minimizing the risk of occupational exposures. The use of specific engineering controls will vary and typically are:
 - mechanical aids (e.g., tongs, tweezers),
 - dead air boxes,
 - sharp containers,
 - laboratory-type fume hoods,
 - biological safety cabinets (BSC),
 - shielding,
 - containment protection for vacuum systems,
 - safety centrifuge cups, and
 - special shipping containers for transporting biological materials and animals
- Examples of facility design controls are depend on the risk of transmission of specific biohazardous agents.
 - high efficiency particulate air (HEPA) filters,
 - interlock systems, and
 - negative airflow units.

Personal Protective Equipment (PPE):

- Identifying and understanding the hazard and then matching the needed PPE to the workplace hazard is the key to selecting effective and appropriate protection. Personal protective equipment is to be used only as supplemental protection if there is still a residual risk of exposure after engineered and administrative controls are implemented, then PPE may be needed. Examples of PPE are:

- gloves,
- coats,
- gowns,
- shoe covers,
- safety shoes where an impact hazard exists,
- boots,
- respirators,

- face shields,
- safety glasses or goggles
- closed-toed shoes shall be worn to protect the feet from common laboratory hazards, (e.g., acids, bases, solvents, broken glass, etc.). Sandal-type shoes are prohibited in areas where such hazards exist.

IV REFERENCES

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